



CANOPY

Advanced Manufacturing for Thermal Protection Systems:

Unlocking the LEO Economy

Founders

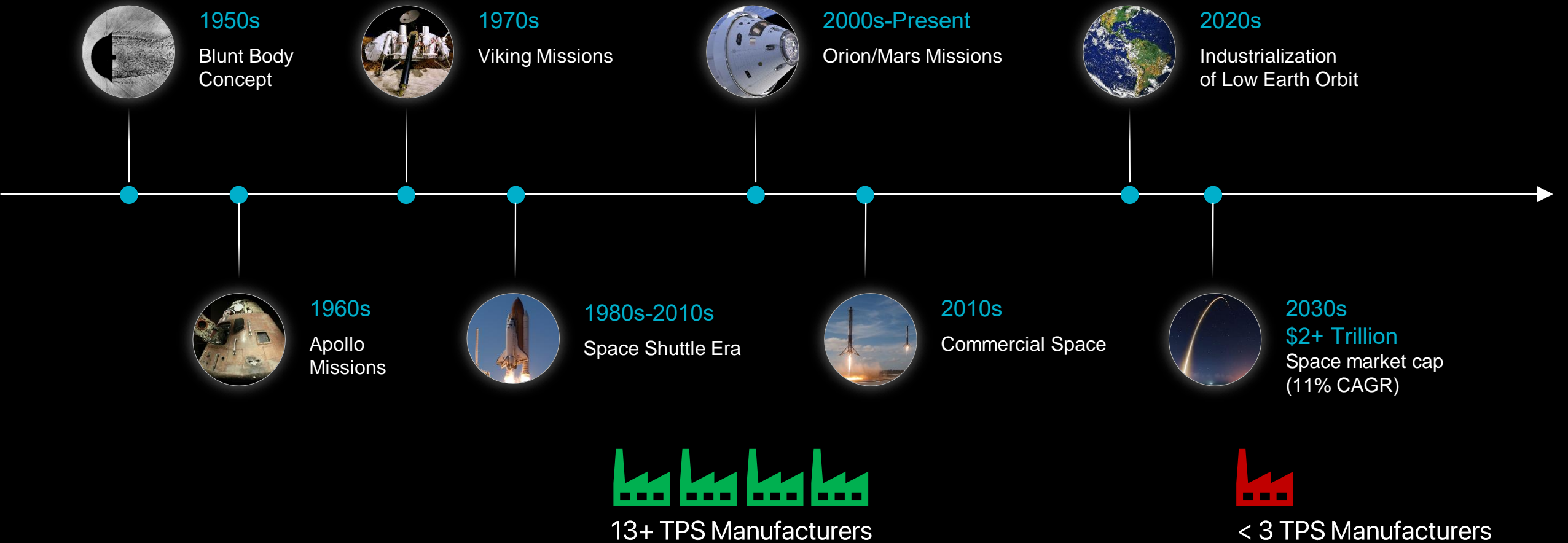
CEO - Matt Shieh
matt@canopyaerospace.com

CTO - John M. Howard, PhD
john@canopyaerospace.com



TPS Developmental Context

The Future Space Vision Does Not Exist Without Thermal Protection



Hundreds of companies are building the future \$2T space economy that enable new modalities of travel

Reusable Rockets

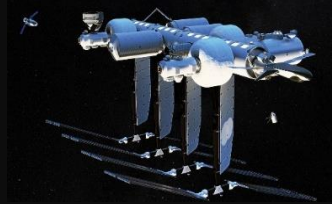


SPACEX

Relativity

FIREFLY
AEROSPACE

Commercial Space Stations



ORBITAL
REEF

VOYAGER
SPACE

AXIOM
SPACE

In-Space Manufacturing



IN ORBIT
aerospace

VARDA
SPACE INDUSTRIES

SPACE FORGE

Space Vehicles



SIERRA
SPACE

RADIAN
AEROSPACE

Virgin GALACTIC

Hypersonics



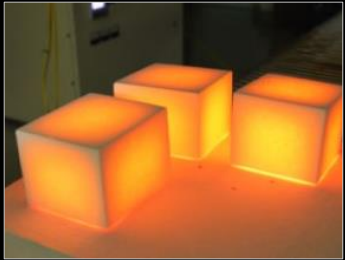
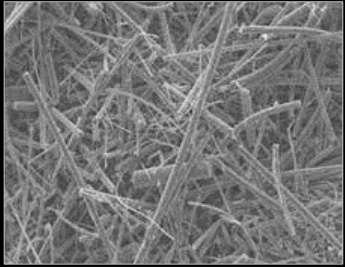
LOCKHEED MARTIN

Raytheon
Missiles & Defense

HERMEUS

Thermal Protection Systems (TPS)

TPS is a single-point failure system that protects vehicles at hypersonic speeds or during re-entry conditions



Orion Lander
1,000 tiles
\$5M*



Sierra Space
2,000 tiles
\$10M*



SpaceX Starship
25,000 tiles
\$125M*



Space Shuttle
30,000 tiles
\$150M*



Typically, a high-temperature resistant, ceramic material

* Estimated Costs

Enabling Technologies for a LEO Economy

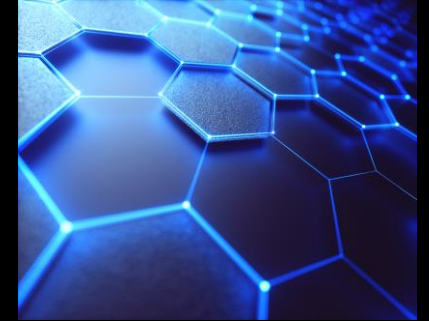
Propulsion Systems



Satellites



Advanced Materials



Navigation Systems



Power Systems



Affordable and accessible heat shields are a challenge for space companies to manufacture

Limited supply base



Lack of applied innovation in 2010s

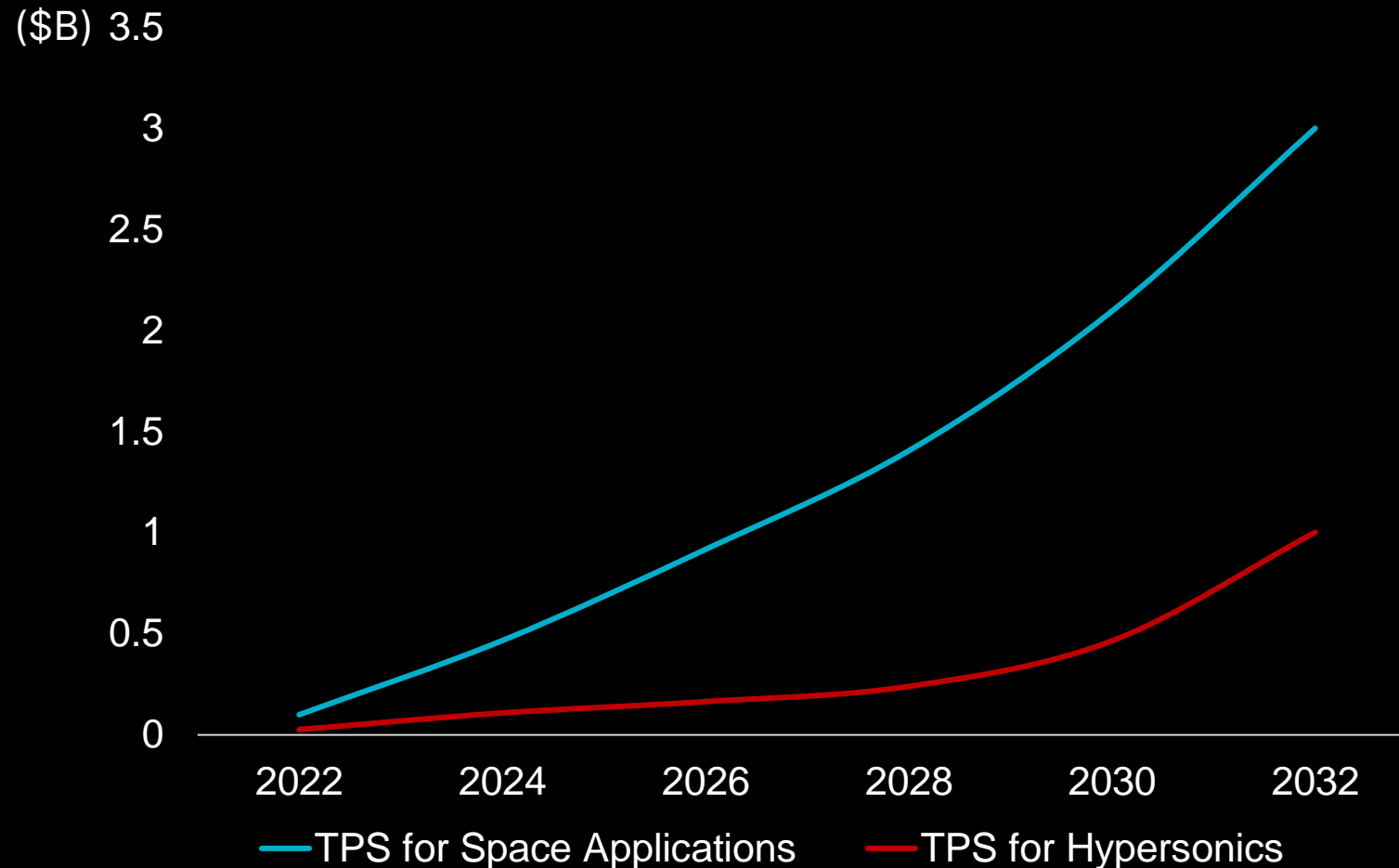


Limited industry expertise



Thermal protection systems represent some of the most critical, unavailable components of the supply base

Thermal Protection needs will scale up in billions over the next decade to support the defense industry



Canopy's Solution: A Fully-Integrated Factory For Heat Shields

Reduced launch costs, shorter lead times, increased flight safety



1. Software-Enabled Design

- Material Selection and Geometry Optimization
- Cost Summary
- Delivery Timeline



2. Advanced Manufacturing

- 3D Printing
- Efficient Operation
- Reduced Costs & Shorter Lead Times



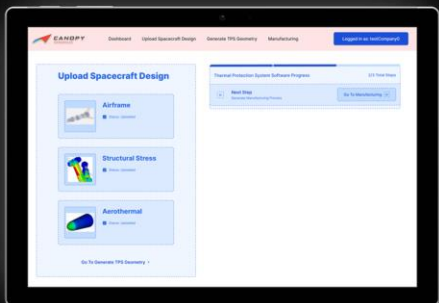
3. Smart Composites

- Sensor Integration
- In-flight Monitoring
- Predictive Maintenance



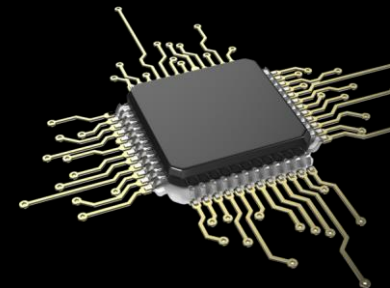
4. Maintenance Services

- Vehicle Inspection
- Rapid Repair
- Replacement/Overhaul



AETB "Shuttle Tile"

Reusable Launch Vehicles



GTM Strategy: Commercializing licensed IP from NASA



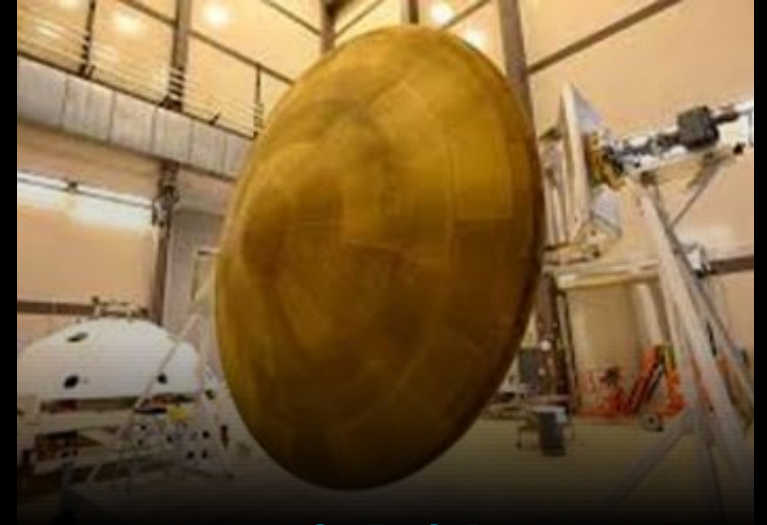
AETB "Shuttle Tile"

Reusable Launch Vehicles



TUFROC

Hypersonic Vehicles



C-PICA

Reentry Capsules

Canopy is leveraging existing, operationally flown materials from NASA for our initial market

We develop IP by **advancing the design and manufacturing process**

Challenges in Ablative TPS Manufacturing: Avcoat

Apollo Missions

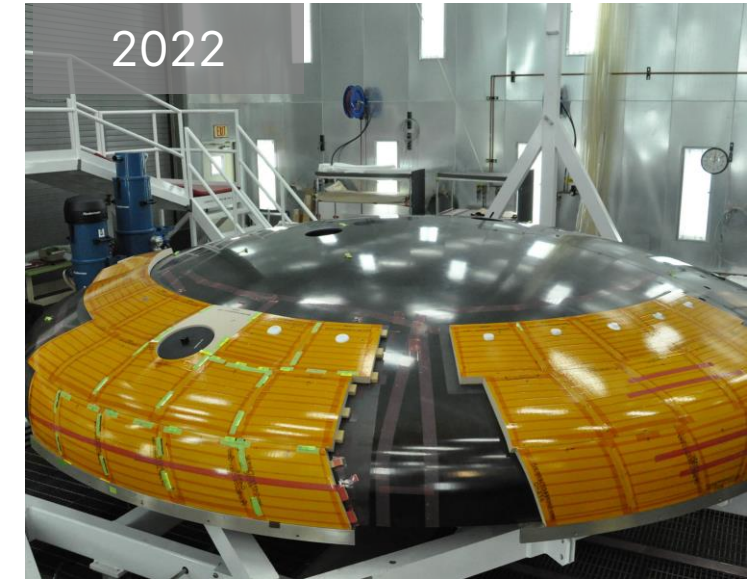


Orion EFT-1



Credit: NASA

Orion EM-1

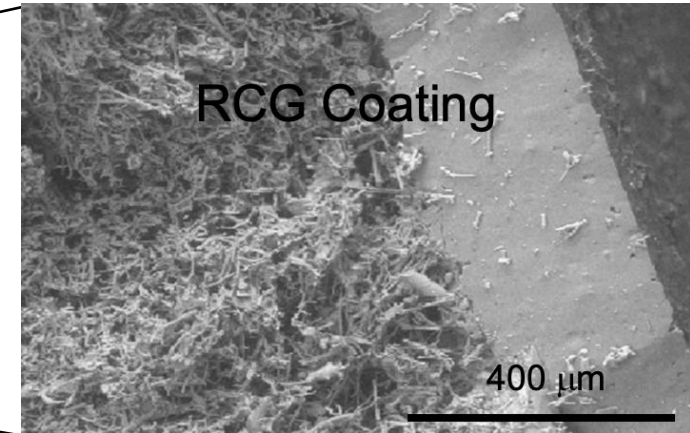


Avcoat's 1960s debut on Apollo, relied on high-touch manual labor.

\$25M spent to recreate the material for Orion EFT-1 flight (>300,000 honeycomb cells)

Orion EM-1 flew with a reformulated material that eliminated the honeycomb and manual filling.

Challenges in Reusable TPS Manufacturing: Shuttle Tile



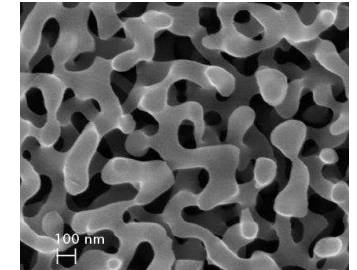
Credit: NASA Ames, S. Johnson 2012

Manufacturing challenges:

- Traditional machining to shape tiles (single tiles take up to 12 hours)
- Skilled operators apply tile coatings by hand
- Fabrication process ~48 hours start to finish
- Installation process remains labor intensive



High-purity silica fiber properties have changed and weakened tiles



Vycor 7930 is used in all tile coatings and has been discontinued

Company Summary

Mission

To assure access to space by pioneering a new era of advanced manufacturing, supported by deep industry knowledge and an unwavering commitment to secure the domestic industrial supply chain.

Team



Matt Shieh



CEO



John Howard
PhD



CTO

\$2M Investment



11 Team Members



Partners





CANOPY



@ matt@canopyaerospace.com

@ john@canopyaerospace.com

🌐 canopyaerospace.com